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REPORT

CD NO.

50X1-HUM

COUNTRY	USSR	DATE OF INFORMATION	1947
SUBJECT	Engineering - Transport, dump truck		
HOW PUBLISHED	Monthly periodical	DATE DIST.	18 March 1949
WHERE PUBLISHED	Moscow	NO. OF PAGES	6
DATE PUBLISHED	May, 1947		
LANGUAGE	Russian	SUPPLEMENT TO REPORT NO.	

THIS IS UNEVALUATED INFORMATION

SOURCE Avtomobilnaya Promyshlennost', No 5, 1947. (FDB Per Abs 12T43 -- Information requested.)

THE YaAZ DUMP TRUCK

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The Yaroslavl' Automobile Plant has produced experimental models of a new Soviet dump truck, YaAZ-205, designed on the basis of the YaAZ-200 automobile truck.

The dump truck chassis differs from that of the YaAZ-200 in that its base is shorter, but the same longeron stamping is used for the frame of both. The 5-ton carrying capacity of the dump truck and construction of the lifting mechanism, which does not place a load on the frame, enabled the longeron section to be left without reinforcement. For the dump truck the back axle bracket has been moved 720 millimeters forward and the superfluous portion of the longerons cut off; the total number of transverse frames has been reduced to five.

The towing arrangement and towing hooks have been retained. The Cardan shafts have been shortened: the first to 614 millimeters, the second to 106 millimeters; in so doing the structure of the Cardan drive has been preserved intact.

The auto-dump truck is intended to operate without a trailer. For this reason all fittings on the pneumatic breaking and electrical equipment systems, which were intended for use with the trailer on the YaAZ-200 truck, have been omitted. The fuel tank capacity has been reduced to 105 liters which is sufficient for a 300-kilometer trip. This considerably increases the hourly mileage of the dump truck. The back axle gear reduction ratio has been increased to 9.00:1, and the maximum speed reduced to 55 kilometers per hour. Raising the gear ratio of the main drive and lowering the maximum speed assure some increase of traction and make it easier for the drive to maintain the Diesel rpm at 1500 and higher under specific conditions of dumping operations. The Diesel runs better within this rpm range. The other alterations are connected with the installation of the dumping mechanism and the platform, its drive and control gear.

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Table 1 give the abridged specifications of the YaAZ-205 automobile dump truck as compared with the YaAZ-200 truck and the YaSZ dump truck produced by the Yaroslavl' plant up to 1941.

Table 1. Specifications of Automobile Dump Trucks

	Auto-Dump Truck YaAZ-205	Truck YaAZ-200	Dump Truck YaSZ
Carrying capacity in tons	5	7	4
Over-all dimensions in mm:			
Length	6,065	7,620	6,240
Breadth	2,615	2,650	2,410
Height	2,430	2,430	2,550
Base in mm	3,800	4,520	4,200
Front wheel track in mm	1,950	1,950	1,780
Rear wheel track between centers of double wheels in mm	1,920	1,920	1,860
Lowest points in mm:			
Beneath front axle	290	290	310
" rear axle	290	290	300
" lifting cylinder	Above frames	--	390
Turning radius of outer front wheel in meters	8.5	9.2	8.5
Angles of entry:			
Front	43°	43°	--
Rear	43°	29°	--
Maximum speed in km/hour	55	60	40
Distribution of axle load in kg (in equipped state without load):			
Front	3,000 (46.2%)	3,120 (48.8%)	2,280 (39.2%)
Rear	3,500 (53.8%)	3,270 (51.2%)	3,540 (60.8%)
Over-all load	6,500 (100 %)	6,290 (100 %)	5,820 (100 %)
(with load, driver and passengers)			
Front	3,450 (29.6%)	3,330 (26.4%)	2,650 (23.7%)
Rear	8,190 (70.4%)	9,970 (73.4%)	7,170 (73.3%)
Over-all load	11,640 (100 %)	13,300 (100 %)	9,820 (100 %)

Table 1 (Contd)

	YaAZ-205	YaAZ-200	YaSZ
Fuel consumption in liters/100 km	35	35	50
Capacity of fuel tank in liters	105	225	177
Engine	Two stroke Diesel		Carburetor
Maximum power in hp	110	110	73
Maximum rpm	2,000	2,000	2,400
Maximum turning moment in kg-m	48	48	30
Gearbox ratios:			
1st gear	6.17:1	6.17:1	6.60:1
2d "	3.40:1	3.40:1	3.74:1
3d "	1.79:1	1.79:1	1.84:1
4th "	1.00:1	1.00:1	1.00:1
5th "	0.78:1	0.78:1	--
Reverse	6.69:1	6.69:1	7.63:1
Gear ratio of main drive	9.00:1	8.21:1	10.9:1
Tires	12.0-20"	12.0-20"	40x8
Internal dimensions of platform in mm:			
Length	3,000	4,500	3,180
Breadth	2,000	2,480	1,900
Height of sideboards	600	600	410
Volume of platform in cu m	3.6	6.7	2.5
Volume of platform with supplementary boards in cu m	4.7	--	3.4
Tipping angle of platform	50°	--	50°
Number of cylinders in hydraulic lifter	1	--	2
Diameter of cylinder in mm	180	--	145
Piston rod travel in mm	540	--	575
Diameter of piston rod travel in mm	52	--	50
Oil capacity of lifter in liters	17.5	--	30
Maximum pressure in kg/sq cm	37	--	17.5
Lifting time in seconds	15	--	25
Lowering time in seconds	15	--	25
Weight of platform in kg	790	--	950
Weight of lifting mechanism in kg	334	--	230

The dynamics of the automobile dump truck have to be better than those of the basic automobile truck as the dump truck must work under more severe road conditions. By lowering the full weight, decreasing the useful load, and also by increasing the gear ratio of the main drive the dynamic factor, which characterizes the capacity of the automobile to accelerate, deal with loads, and travel along poor roads, has been increased by 27 percent as compared with the basic truck. The fifth gear in the gearbox increases the maximum speed of the automobile to 55 kilometers per hour, which is especially important during return trips.

Table 2 shows the values of the dynamic factor of the same automobiles on direct drive and the maximum and minimum speeds at 1,100 hpm in first gear.

Table 2. Dynamics of Automobile Dump Truck

	Dynamic Factor in kg/kg	Maximum Speed in km/hr	Minimum Speed in km/hr
YaAZ-200	0.0464	60	4.37
YaAZ-205	0.0588	55	4.00
YaSZ	0.0486	40	3.00

Good dynamics predetermine good economy and road-holding capacity. To improve the maneuverability of the dump truck it has been made as short as possible. The low-minimum speed enables difficult strips of road to be surmounted at maximum turning moment without slip. To cope with especially severe conditions, the feasibility of using tires with ground checking devices, antiskid chains and a supplementary gear box will be examined.

A supplementary gear box on a dump truck enables the minimum speed of be halved, with a corresponding increase in tractive force, thereby considerably improving the road-holding capacity of the automobile. Moreover, a supplementary gear box enables the working conditions of the engine to be properly chosen with respect to the conditions of travel, which increases its economy.

The hydraulic lifting mechanism of the dump truck consists of a horizontally disposed cylinder which swivels about a cross shaft attached to the frame.

The cylinder is made from steel tubing bored to a diameter of 180 millimeters and honed. The cast steel cylinder head, which is electrically welded to the cylinder, fulfills the dual purpose of an angle bracket for the swivel connection with the cross shaft and a base for connecting the pump to the control valve. There are two passages in the head for connecting the interior of the cylinder with the pump.

The cylinder base is of cast iron. The 52-millimeter diameter piston rod is of chrome steel. To avoid oil leakage from the cylinder and dust penetration into it, a double leather gasket is fitted in the opening for the piston rod. The cast-iron piston, with three cast-iron piston packing rings, is attached to the inner end of the piston rod by a nut. A steel tube is welded by the side of the cylinder, the front end to the cylinder head, the rear end to a lug on the cylinder body. This tube connects the cylinder cavities divided by the piston through the control valve and the pump. A stamping of irregular profile, and a strap provide a swivel connection between the front end of the piston rod and the middle levers of the lever-

lifting mechanism. The lever mechanism is welded, and the two middle and two double lateral levers, cut from steel sheets are welded to a steel tube This mechanism is joined to the frame by a cross shaft and to the platform by two welded box-section levers.

The rear end of the platform also has a swivel connection with the frame through an angle bracket and pins. The cast-iron body of the pump and control valve is joined to the cylinder head on four studs with a paronite gasket so that one passage is connected with the side tube and the other directly to the cylinder. The pump and the control and reducing valves are arranged in the body.

The pump is of the gear wheel type. The drive is through two Cardan shafts from the power-selection box located by the first door of the gear box. The gear ratio of the power-selection box is 1:1.

The dumping mechanism is controlled by two levers in the cab to the right of the driver. The first lever cuts the power selection in or out, the "In" position is forward. The second lever controls the valve: position "Stop," hard forward; position "Lift," in the middle; position "Lower," hard back.

The platform is welded from 4-millimeters sheet steel. The rear board can hinge about the upper pins when the platform is tilted, about the lower pins when the platform is used as an ordinary truck, and finally can be hung on chains in a horizontal position. The high front and rear boards, and also the openings and clamps in the sideboards, allow the platform boards to be built up to increase capacity when carrying light loads. When the side boards are built up level with the front, the platform capacity is increased to 4.7 cubic meters and it is possible to increase the height of all the boards still further, thus obtaining and additional increase of capacity.

The lifting mechanism operates on the following principle. Having pressed the clutch pedal, the driver puts the power selection lever in the front position, lets go of the clutch pedal, thereby cutting in the pump. Having put the control lever in the middle position, he increases the engine rpm to 1,500 and lifting takes place. Oil from the part of the cylinder above the piston is pumped to the part of the cylinder below the piston. The piston pushes the rod out due to the oil pressure, which reaches 37 atmospheres, and raises the platform to an angle of 50 degrees through the level system. At the end of the piston's travel, two openings are made in the cylinder body, connecting the cylinder with the pump through a by-pass valve. In the extreme position the piston is so situated between these openings that the lower and upper parts of the cylinder are connected and the oil from the high pressure side is by-passed into the upper part, until the piston on its downstroke again covers the lower opening. Thus automatic cessation of lifting with a continuously running pump is assured.

On completion of lifting the power selection is cut out, the control lever is moved to the "Lower" position, hard back, and the platform is lowered to the horizontal position. The lifting and lowering speeds can be regulated by the position of the control lever. The platform can be left raised in any position by putting the control lever in the "Stop" position, hard forward.

The cylinder is charged with spindle oil, through a plug in its upper part. It is necessary to raise the platform a little when pouring in the oil. After the oil has been poured into the cylinder, the platform should be raised and lowered several times with the pump running and oil added, until it flows out of the filling hole.

The new 5-ton dump truck will be of great assistance in mechanizing laborious loading and unloading operations, especially in industrial construction, road building and also in transporting agricultural loads.

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